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MINE EXPLOSIONS AND FIRES IN THE UNITED STATES DURING THE FISCAL YEAR ENDING JUNE 30, 1931

BY

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MINE EXPLOSIONS AND FIRES IN THE UNITED STATES DURING THE FISCAL YEAR ENDING JUNE 30, 1931[1]

By D. Harrington[2]

Approximately 2,000 persons are killed annually in the coal mines of the United States. There is no question that this number is at least double and probably treble what it should be and by all means the least excusable of the fatalities are those caused by explosions and fires. Fatalities from explosions and fires in coal mines are almost invariably caused by carelessness or negligence. Table 1 indicates that the fiscal year ending June 30, 1931, was by no means a satisfactory one as regards either the number of explosions or the number of persons killed by them. This tabulation lists all ignitions to which the attention of the personnel of the safety division was called and includes not only major disasters, but also explosions in which fewer than five were killed, as well as several explosions from which no fatalities resulted.

It will be noticed that last year there were 26 explosions in mines in 10 States of the United States, resulting in 217 deaths. In the previous year there were 34 explosions with a death list of 199, and in the year before there were 38 explosions with a death list of 139. Hence, the past fiscal year had distinctly a poorer record of fatalities from mine explosions than either of the two previous years.

Of the 26 explosions in the past fiscal year, Pennsylvania had 7, West Virginia 4, New Mexico and Ohio 3 each, Alabama, Oklahoma and Washington 2 each, and California, Illinois and Indiana 1 each; the one in California was in a tunnel being driven for water purposes but giving off explosive gas (methane). In fatalities Ohio had the worst record with 88, Oklahoma came next with 45, then Indiana with 28, and Pennsylvania with 23; although Alabama had 2 ignitions and Washington 1, they caused no fatalities. Utah, Colorado, and Kentucky had no explosions reported by the safety division of the Bureau of Mines during the past fiscal year, but were on the list for the previous year, though in the case of Colorado there were no fatalities. On the other hand, Indiana and New Mexico, neither of which was charged with an explosion in the two previous years, were on the list for the past fiscal year; New Mexico had the bad record of three explosions, though fortunately with but a total of eight fatalities. Ohio reported 3 explosions to the safety division of the Bureau of Mines in the past fiscal year, 2 in the previous year, and 3 in the year before that, or 8 in the past three fiscal years with 92 fatalities; all of these eight explosions were in open-light mines.

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[1] The Bureau of Mines will welcome reprinting of this paper, provided the following footnote acknowledgment is used: "Reprinted from U. S. Bureau of Mines Information Circular 6540."

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Table 1.- Summary of mine explosions by States, July 1, 1930 to June 30, 1931

	Lighting				Fatalities by ignition causes									
					Electricity		Open lights or smoking		Explosives		Unknown		Total	
	Open	Closed	Unknown	Total mine explosions	Deaths	Ignitions	Deaths	Ignitions	Deaths	Ignitions	Deaths	Ignitions	Deaths	Ignitions
Alabama	2	0	-	2	0	0	0	2	-	-	-	-	0	2
California[1] ..	-	1	-	1	12	1	-	-	-	-	-	-	12	1
Illinois	-	1	-	1	2	1	-	-	-	-	-	-	2	1
Indiana	1	-	-	1	-	-	28	1	-	-	-	-	28	1
New Mexico ..	1	2	-	3	7	2	0	0	1	1	-	-	8	3
Ohio	3	-	-	3	82	1	0	0	6	2	-	-	88	3
Oklahoma	-	2	-	2	30	1	15	1	0	0	-	-	45	2
Pennsylvania[2]	3	5	-	7	0	0	12	4	11	3	-	-	23	7
Washington ..	1	1	-	2	-	-	0	2	0	0	-	-	0	2
West Virginia	1	3	-	4	10	3	1	1	-	-	0	0	11	4
Total United States fiscal year ending June 30, 1931	12	15	0	26	143	9	56	11	13	6	0	0	217	26
Total United States fiscal year ending June 30, 1930[3]	8	25	1	34	154	10	21	8	24	6	0	2	199	34
Total United States fiscal year ending June 30, 1929[4]	18	19	1	38	93	18	14	11	26	8	6	1	139	38

[1] These explosions occurred in tunnels where methane was being given off and where incandescent lighting was in use.

[2] One mine operated with mixed lights.

[3] See Information Circular 6419, January, 1931.

[4] See Information Circular 6178, October, 1929.

Table 1 shows that 143 out of the 217 fatalities in explosions in the past fiscal year were from explosions with ignition by electricity, again demonstrating that electricity is one of the most dangerous agencies in our mines; 56 of the 217 fatalities were from explosions caused by open lights--far more than the 21 fatalities from that cause in the previous fiscal year and the 14 in the year before; 18 of the 217 deaths from last year's explosions were from explosions started by explosives or blasting, a decrease from the 24 or the 26 from this cause in the two previous years.

EXPLOSIONS CAUSED BY ELECTRICITY

Table 1 shows that but 9 of the 26 explosions for the past fiscal year were caused by electrical ignition, though 143 of the 217 deaths were due to those 9 explosions of electrical origin. Table 2 below lists the electrical causes of explosions not only for the fiscal year ended June 30, 1931, but also for the two previous fiscal years.

Table 2.- Electrical causes of explosions

Causes	Number of ignitions			Total, three years
	1928-1929[1]	1929-1930[2]	1930-1931	
Trolley or cable-reel locomotive..	5	5	1	11
Nonpermissible mining machine	5	5	3/ 3	13
Nonpermissible motor	4	3		7
Nonpermissible shot-firing battery	-	4/ 2	4/ 5/ 3	2
Cable nips or blow-out	-	2		2
Nonpermissible storage-battery locomotive	1	1	6/ 2	4
Shot-firing line	-	1		1
Faulty wiring	2	1		3
Trolley wire	1	-	7/ 2	3
Electric arc	2	-	8/ 1	
Total ignitions	20	18	9	49

1 See Information Circular 6178.
2 See Information Circular 6419.
3 Thirty-four killed.
4 Not included in totals; may have been from overcharged shots and therefore are listed as explosives accidents in Table 1.
5 Ten killed.
6 Twenty killed.
7 Eighty-four killed.
8 Five killed.

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It will be noticed that 49 explosions in the last three fiscal years were started by electricity (resultant deaths from these 49 explosions amounted to 390, see Table 1); 11 of these 49 explosions were caused by trolley or cable-reel locomotives, 4 by nonpermissible storage-battery locomotives, and 3 by trolley wire, or 18 out of the 49 by nonpermissible locomotives or wiring for locomotives; surely this in itself is a severe indictment of the use of such equipment in any coal mine; in the past fiscal year one explosion with 82 fatalities was caused by an arc from a fall of roof material on a trolley wire. Thirteen of the 49 explosions of electrical origin in the past three years were due to nonpermissible mining (coal-cutting) machines; there isn't in the record even one explosion caused by a permissible mining machine, and since efficient permissible mining machines are available to all, there doesn't appear to be any good reason why nonpermissible mining machines should be used in coal mines. Of the 49 explosions of electrical origin during the past three fiscal years, 37 or 75 per cent were due to nonpermissible electrical equipment (locomotives, mining machines, motors, and shot-firing batteries); when it is remembered that these 49 explosions caused 390 fatalities, not one due to permissible electrical equipment, one marvels that nonpermissible electrical equipment is allowed in coal mines; there is at any rate every warrant for the exclusion of nonpermissible equipment from any mine or part of mine which gives off methane or has coal-dust undiluted by thorough rock-dusting.

CAUSES OF EXPLOSION IGNITIONS FOR THE PAST FOUR FISCAL YEARS

Table 3 lists the explosions by number and cause of ignitions during the past four fiscal years as reported by the field personnel of the safety division of the United States Bureau of Mines.

Table 3.- Comparison of explosion ignition causes, fiscal years 1927-28 to 1930-31, inclusive

Years	Electricity		Open lights or smoking		Explosives		Unknown		Total	
	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent
1927-28	14	45.1	12	38.7	3	9.7	2	6.5	31	100.00
1928-29	18	47.4	11	29.0	8	21.0	1	2.6	38	100.00
1929-30	18	52.5	8	23.5	6	18.0	2	6.0	34	100.00
1930-31	9	34.6	11	42.3	6	23.1	0	0.0	26	100.00
Total	59	45.8	42	32.5	23	17.8	5	3.9	129	100.00

It will be seen that in the last fiscal year 34.6 per cent of the explosions reported to the safety division of the Bureau of Mines were started by electricity, and for the past four years 59 out of 129 explosions, or 45.8 per cent, were caused by electricity; last year 42.3 per cent of the explosions were caused by open lights or smoking, while for the past four years 42 out of 129 explosions or 32.5 per cent were caused by open lights or smoking. Last year 23.1 per cent of the explosions were started by explosives or blasting, and for the 4-year period 23 of the 129 explosions or 17.8 per cent were due to blasting. It is distinctly disquieting to realize that notwithstanding all that is known about prevention of explosions, those disasters continue in our mines and have occurred at an average of 32 per year for the past four years.

FATALITIES FROM VARIOUS EXPLOSION IGNITION CAUSES

Table 4 shows that in the mines of the United States during the past four years 897 persons have been killed in explosions to which attention of the safety division personnel has been called. The fiscal year 1927-28 had the worst record with its 342 fatalities from explosions, and the past fiscal year (1930-31) was second with 217 killed; the record of the latter year, however, was but little worse than that of the preceding year (1929-30) when the explosion fatalities in mines reached 199.

Table 4.- Comparison of explosion fatalities by ignition causes, fiscal years 1927-28 to 1930-31, inclusive

Years	Electricity		Open lights		Explosives		Unknown		Total	
	Number killed	Per cent	Number killed	Per cent	Number killed	Per cent	Number killed	Per cent	Number killed	Per cent
1927-28	282	82.5	49	14.3	9	2.6	2	0.6	342	100.00
1928-29	93	66.9	14	10.1	26	18.7	6	4.3	139	100.00
1929-30	154	77.5	21	10.5	24	12.0	0	0.0	199	100.00
1930-31	143	65.9	56	25.8	18	8.3	0	0.0	217	100.00
Total (4 years)	672	74.8	140	15.6	77	8.7	8	0.9	897	100.00

In the past fiscal year 143 fatalities occurred in explosions started by electricity, these deaths amounted to 65.9 per cent of the 217 killed in all explosions; the fact that during the past four years 672 persons have been killed in our mines in explosions started by electricity is one which should cause every right-minded mining man to take prompt decisive action toward safeguarding his employees from possible disasters because of defective electrical equipment or misuse of electrical equipment in mines. During the last four years 74.8 or essentially 75 per cent of the fatalities from explosions in our mines have been due to explosions started by electricity!

In the past fiscal year open lights caused explosions which accounted for 25.8 per cent of the explosion fatalities, this being more than double the percentage for either of the two previous years and nearly double the rate for the fiscal year ending June 30, 1928; moreover, the open light was not charged with ignition of an explosion with heavy loss of life in an open-light mine, though some people believe that this disaster might well be charged to open lights; there is no question that the open light is ever a menace to the safety of all the workers of any mine which uses it.

In the year ended June 30, 1931, blasting or the use of explosives caused explosions with 18 fatalities, or 8.3 per cent of the total for the year, this percentage being essentially the same as the 8.7 per cent for the 4-year period ending June 30, 1931. Precautions taken in the use of explosives in mines are being extended year by year, and there is good reason to hope that mine explosions with heavy loss of life due to blasting will gradually disappear—unless some of the relaxations now being taken in blasting for mechanized loading should cause some bad disasters, and this is by no means improbable.

The fact that in the last four fiscal years 897 persons were killed in explosions in our mines is a sad commentary on the efficiency of our mining men, as there is absolutely no question that mine explosions are preventable and that practically all of them are the result of carelessness. There is, however, a silver lining to this cloud; during the last five months of the fiscal year ended June 30, 1931, there were but 10 fatalities in coal mines of the United States from explosions; moreover the bituminous mines of Pennsylvania with upwards of 130,000 employees have not had a major disaster (one with five or more killed) since March 21, 1929, or for nearly 2½ years; this shows what can be done.

Table 5.- Comparison of lighting in mines where explosions occurred, fiscal years 1927-28, to 1930-31, inclusive

Year	Open lights		Closed lights		Lighting Unknown		Total	
	Number of explosions	Per cent	Number of explosions	Per cent	Number of explosions	Per cent	Number of explosions	Per cent
1927-28	14	45.1	15	48.4	2	6.5	31	100.00
1928-29	18	47.4	19	50.0	1	2.6	38	100.00
1929-30	8	23.5	25	73.5	1	3.0	34	100.00
1930-31	12	44.4	15	55.6	0	0.0	[1] 27	100.00
	52	40.0	74	56.9	4	3.1	[1] 130	100.00

[1] One mine had mixed (open as well as closed) lighting.

Table 5 shows that in the past fiscal year 12 out of 27 explosions, or 44.4 per cent, were in open-light mines, while 15 or 55.6 per cent were in closed-light mines; for the past four fiscal years 52 of 130 explosions, or 40 per cent, were in open-light mines and 74 or 56.9 per cent were in closed-light mines. The significance of this is subject to some debate, but one thing must be kept in mind very definitely: Open lights have caused numerous explosions (in fact, nearly all of them) in open-light mines (and a few in so-called closed-light mines), but no permissible electric cap lamp has ever caused an explosion in any mine whether on an open or a closed light basis. The closed-light mines are usually those known to be dangerous because of gas or dust or both, hence have potential hazards much in excess of those in which open lights are allowed ordinarily; however, there is no question that where closed lights are used mining companies in many instances are prone to rely too much on the safety features of closed lights and to take far too many chances with nonpermissible electrical equipment, to use electrical equipment under dangerous conditions as to gas or dust or both, and only too frequently ventilation precautions are relaxed, apparently with the idea that the closed lights will prevent trouble from those relaxations or deficiencies in safety practice. Open lights ought not to be allowed in any mine, particularly any coal mine, as there will continue to be fires and explosions in mines as long as open lights or any type of open flame is allowed underground; there will also continue to be fires and explosions in closed-light mines as long as unsafe electrical equipment, unsafe practices with electricity, unsafe blasting materials and practices, and various kinds of carelessness with ventilation are allowed in closed light mines. In other words, while open lights are at all times and under all circumstances dangerous in mines, on the other hand closed lights in themselves are by no means a cure-all for the ills of underground workers or workings.

Table 6 lists the mine fires to which the personnel of the safety division were called or with which they were in contact during the fiscal year ending June 30, 1931. It will be noticed that there were 24 fires with 23 fatalities in 14 States. In the previous fiscal year the safety division also sent men to 24 fires in 14 States; fatalities, however, were but five. In the past fiscal year 12 of the fires were in open-light mines as against but 7 in open-light mines in the previous year; last year 7 fires were in closed-light mines as against 8 in the previous year; the lighting system was unknown in five mines which had fires in the past fiscal year, and in nine mines the previous year.

Electricity caused 7 fires but no fatalities from those fires in the past fiscal year, as against 9 fires with 2 fatalities in the previous year; 3 fires with 5 fatalities were caused by open lights or smoking in the past year as against 6 fires and 3 fatalities in the previous year; explosives caused 5 fires with no fatalities last year and 3 fires with no fatalities in the previous year (it is probable that several hundred coal-mine fires were caused by explosives, but in general they were not called to the attention of the safety division of the Bureau of Mines); last year 9 fires due to miscellaneous or unknown causes with 18 deaths were attended by the safety division personnel; one of these, causing 11 deaths in a city tunnel being driven for sewer purposes, was probably caused by smoking, though it may have been due to defective wiring. Three of the 24 fires listed in Table 6 were not in coal mines; one with 11 fatalities was in a tunnel being driven in a city, and 2 with 2 fatalities were at metal mines.

In addition to 26 explosions with 217 fatalities, and 24 fires with 23 fatalities, the personnel of the safety division had fairly close contact during the past fiscal year with 45 other miscellaneous accidents with 75 fatalities, a total of 95 accidents of all kinds with fatality total of 315. In the previous fiscal year safety division personnel were in contact with 34 explosions with 199 fatalities, 24 fires with 5 fatalities, and 29 miscellaneous accidents with 72 fatalities, a total of 87 accidents of all kinds with 276 fatalities.

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Table 6.- Summary of mine fires by States, July 1, 1930 to June 30, 1931

	Lights				Fatalities by ignition causes									
					Electricity		Open lights or smoking		Explosives		Mis-cellaneous		Total	
	Open	Closed	Un-known	Total	Deaths	Igni-tions	Deaths	Igni-tions	Deaths	Igni-tions	Deaths	Igni-tions	Deaths	Igni-tions
Alabama	-	-	1	1	-	-	-	-	-	-	0	1	0	1
California ..	1	1	-	2	0	0	5	1	-	-	0	1	5	2
Colorado	-	-	1	1	-	-	-	-	-	-	0	1	0	1
Illinois	1	-	1	2	0	1	-	-	-	-	11	1	11	2
Indiana	2	-	-	2	-	-	-	-	0	2	0	-	0	2
Kentucky	2	0	-	2	0	1	0	0	0	1	-	-	0	2
Ohio	2	0	-	2	0	1	0	0	-	-	4	1	4	2
Oklahoma	0	2	0	2	0	1	0	0	0	1	-	-	0	2
Pennsylvania.	1	0	-	1	0	1	0	0	0	0	-	-	0	1
South Dakota.	1	0	0	1	0	0	0	0	0	0	2	1	2	1
Utah	0	1	0	1	0	0	-	-	-	-	0	1	0	1
Washington...	-	2	-	2	0	1	-	-	-	-	0	1	0	2
West Virginia	1	1	2	4	0	1	0	1	0	1	1	1	1	4
Wyoming	1	-	0	1	-	-	0	1	-	-	0	0	0	1
Total fiscal year ending June 30, 1931	12	7	5	24	0	7	5	3	0	5	18	9	23	24
Total fiscal year ending June 30, 1930[1]	7	8	9	24	2	9	3	6	0	3	0	6	5	24

[1] See Information Circular 6419, issued January, 1931.

CONCLUSION

Although it is disheartening to realize that more men were killed in mine explosions during the fiscal year ending June 30, 1931 than in either of the two previous years, there are several causes for congratulation to be found in the mine explosion record of the past year. The 3-month period November 1, 1930, to February 1, 1931, was one of the worst 3-month periods in the history of bituminous coal-mining in the United States in point of occurrence of major disasters (there having been seven major disasters with 173 fatalities), but the succeeding 5-month period to the end of the fiscal year had unquestionably the best record of any similar period in the past 30 years, as there was not a single major disaster in any bituminous coal mine and there was but one in anthracite mines, resulting in loss of five lives. This immunity from major disasters during the late winter and spring months is unusual; these are the months in which some of the worst disasters in coal mining in the United States have occurred. At least two gas explosions were stopped by rock-dust, and there is very good cause to believe that the fatality list for the year would have been extended by at least 100 had it not been for rock-dusting.

It is a cheering fact that Colorado, Kentucky, and Utah do not appear in the list of States having explosions during the past year, and that Alabama and Washington had no fatalities from explosions. When the hundreds of gassy and dusty bituminous mines of Pennsylvania can operate for nearly 2½ years without a major explosion disaster, the person who believes that explosions of a widespread nature can not be prevented, will certainly be forced to revise his belief; unquestionably two of the main contributing causes to this very excellent record of the bituminous mines of Pennsylvania are the increased activity in the inspection of the installation and use of electricity in bituminous mines, and also the extension of the use of rock-dust. When the bituminous mines of Pennsylvania with over 130,000 employees and with hundreds of gassy mines can operate nearly 2½ years, producing much over 300,000,000 tons of coal without a major disaster, and when all of the bituminous and lignitic mines of the United States can operate more than eight months (from January 28, 1931, to the date of writing this paper) without a major disaster, it is futile for anyone to deny that widespread explosions are preventable. There is no question that such occurrences can be avoided, and there is every reason to believe that within the next few years it will be found that the death rate from explosions in the mines of the United States will be reduced at least 50 per cent and very probably as much as 90 per cent.

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